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| 10/674,631 | 09/29/2003 | Shashank C. Deshmukh | 8233/ETCH/SILICON/JB | 4703 |
| 55649 | 7590 | 09/07/2007 | | |
| MOSER IP LAW GROUP / APPLIED MATERIALS, INC. 1040 BROAD STREET 2ND FLOOR SHREWSBURY, NJ 07702 | | | EXAMINER UMEZ ERONINI, LYNETTE T | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--|--|--|
| Office Action Summary | Application No. 10/674,631 | Applicant(s) DESHMUKH ET AL. | |
| | Examiner Lynette T. Umez-Eronini | Art Unit 1765 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 June 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 and 42-51 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 and 42-51 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections – 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1, 2, 4, 5, 7, 8, 9, 10, and 42; 11, 12, 15, 16, 18, 19, 20, 21 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US 5,835,221), in view of Yu et al. (US 5,131,752).

Lee discloses a method used to monitor film thickness. Polarized light is made incident on the surface of a substrate with a film thereon that has a different reflectivity than that of an underlying substrate. The substrate is subjected to conditions that change the thickness of the film on the substrate. The polarized light that is reflected

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from the substrate is detected at a selected wavelength or wavelengths and a trace of the intensity of the reflected light both parallel and perpendicular to the substrate surface overtime is obtained (Abstract). Lee further discloses the etching endpoints are identified by the cessation of oscillation or a change in slope of ellipsometric parameters in time as describe in US Patent 5,494,697, to Blayo et al., which is incorporated by reference.

Lee further discloses measuring the thickness of a patterned layer or layers of material on a substrate surface wherein the layers comprise 1500 Å (~150 nm) oxide (same as Applicants' high-k dielectric material layer and high-k gate dielectric layer), which overlies a 1125 Å (~112 nm) TiN, and 1625 Å (~162 nm) polysilicon (Table 1) and which were etched at 2.0 eV, 2.8 eV, 3.3 eV, and 4.0 eV (~ 620 nm, 443 nm, 376 nm, and 310 nm). Lee also discloses an oxide mask having a thickness of 1000 to 2000 Å (100-200 nm), 1000 Å thick titanium nitride formed over a 2000 Å (200 nm), polysilicon film and 70 Å (7 nm), thick gate oxide (column 7, lines 38-50).

As to claims 1-5, 7-10, and 42; 11, 12, 14-16, 18-21, and 43, the aforementioned reads,

A method for determining the endpoint of an etch process, comprising:

- (a) providing a substrate comprising a material layer having an initial thickness;
- (b) etching the material layer on the substrate;
- (c) directing radiation onto the substrate as the material layer is etched;
- (d) measuring a change in intensity for radiation reflected from the substrate at a pre-selected wavelength as the material layer is etched; and

(e) terminating the etch step upon measuring a predetermined metric for the change in intensity radiation reflected from the substrate at the pre-selected wavelength.

Lee differs in failing to teach wherein the radiation has a wavelength in nanometers is on the order of magnitude as the initial thickness of the material layer in Angstroms, in claim 1.

Yu teaches a method for endpoint control of thickness of 400 Angstroms silicon dioxide film with a wavelength of 6328 Å (~ 632.8 nm), (Abstract; column 5, lines 7-32; and column 7, lines 7-40) which reads on a wavelength (632.8 nm) in nanometers is on the order of the initial thickness (400 Å) in Angstroms.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Lee by using Yu method of endpoint control for the precisely stopping when a film thickness has attained a desired value (Yu, column 6, lines 9-11).

4. Claims 6 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US '221) in view of Yu (US '752), as applied respectively to claims 1-5 and claim 11 above, and further in view of Jerbic (US 5,348,614).

Lee in view of Yu differs in failing to teach filtering wavelengths other than the pre-selected wavelength.

Jerbic discloses, "Actinometry equipment is commercially available, for example, from EG&G Princeton Applied Research, which manufactures a single spectrometer with multiple wavelength sensing of up to 512 wavelengths simultaneously using

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sensors with appropriate filters. Such equipment has been used to sense the endpoint of a plasma assisted process, such as a plasma etch process by sensing for the appearance, or disappearance, of certain wavelengths emitted by a particular species" (column 3, line 66 – column 4, line 6).

Since Jerbic illustrates optical filters can single out certain wavelengths emitted by a particular species in the endpoint of a plasma etch, then one having ordinary skill in the art at the time the invention was made would have been obvious to modify Lee in view of Yu by using a filter as taught by Jerbic for the purpose of sensing the endpoint in a plasma etch process (Jerbic, column 4, lines 2-6).

5. Claims 3 and 42, as applied to claim 1 above; 13-14 and 43, as applied to claim 11 above; and 44-46 and 48-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee (US '221) in view of Yu (US '752), and further in view of Ngai et al. (US 6,518,106 B2).

Lee in view of Yu differ in failing to teach wherein the thickness of the material layer and gate dielectric layer is 5 to 300 Angstroms, respectively **in claims 3, 14, and 44;**

wherein the gate dielectric layer comprises at least one film of hafnium dioxide (HfO_2) and hafnium silicate (HfSiO_2), **in claim 13;** and

wherein the thickness of the material layer and gate dielectric layer is 20 to 200 Angstroms, respectively **in claims 42 and 43.**

Ngai teaches forming gate dielectric over a semiconductor substrate in forming a transistor and thermally growing the gate dielectric to a thickness of approximately 1 to 50 Angstroms. Ngai also teaches the gate dielectric is SiO_2 and can be an oxide such as HfO_2 (same as Applicants' high k material layer and gate dielectric layer), (column 2, lines 34-56).

Since Ngai illustrates using SiO_2 and HfO_2 as gate dielectric and using a materials such as a high-k dielectric constant is known, then it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to select HfO_2 as a gate dielectric (same as Applicants' high k material layer and gate dielectric layer), as well as a high k dielectric material having a thickness as taught in the Ngai reference because their use is known in manufacturing of semiconductor devices such as transistors (Ngai, column 1, lines 6-9 and column 2, lines 34-56, and column 4, lines 10-12).

6. Claim 47 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US '221) in view of Yu (US '752) and Ngai (US '106 B2), as applied respectively to claim 44 above, and further in view of Jerbic (US '614).

Lee in view of Yu and Ngai differ in failing to teach filtering wavelengths other than the pre-selected wavelength.

Jerbic discloses, "Actinometry equipment is commercially available, for example, from EG&G Princeton Applied Research, which manufactures a single spectrometer with multiple wavelength sensing of up to 512 wavelengths simultaneously using sensors with appropriate filters. Such equipment has been used to sense the endpoint

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of a plasma assisted process, such as a plasma etch process by sensing for the appearance, or disappearance, of certain wavelengths emitted by a particular species" (column 3, line 66 – column 4, line 6).

Since Jerbic illustrates optical filters can single out certain wavelengths emitted by a particular species in the endpoint of a plasma etch, then one having ordinary skill in the art at the time the invention was made would have been obvious to modify Lee in view of Yu and Ngai by using a filter as taught by Jerbic for the purpose of sensing the endpoint in a plasma etch process (Jerbic, column 4, lines 2-6).

Response to Arguments

7. Applicant's arguments with respect to claims 1-21 and 42-51 have been considered but are moot in view of the new ground(s) of rejection because the formerly applied references failed to teach " . . . wherein the radiation has a wavelength in nanometers that is on the order of the initial thickness of the material layer in Angstroms, in (Currently Amended) Claim 1 and 11; and the limitations in (New) Claims 44-51.

8. Applicant's arguments, see Remarks (see pages 4-7), filed 6/7/2007, with respect to the rejection(s) of claim(s) 1, 2, 4, 5, 7-10, 11, 12, 15, 16, 18-21, and 43 over Lee et al. (US 5,835,221) under 35 U.S.C. 102 (b); claims 6 and 17 over Lee (US '221) in view of Jerbic (US 5,348,614) under 35 U.S.C. 103 (a); claims 3 and 42; and 13, 14, and 43 over Lee (US '221) in view of Ngai (US 6,518,106 B2) under 35 U.S.C. 103 (a)

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have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of

claims 1, 2, 4, 5, 7, 8, 9, 10, and 42; 11, 12, 15, 16, 18, 19, 20, 21 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US 5,835,221), in view of Yu et al. (US 5,131,752);

claims 6 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US '221) in view of Yu (US '752), as applied respectively to claims 1-5 and claim 11 above, and further in view of Jerbic (US 5,348,614);

claims 3 and 42, as applied to claim 1 above; 13-14 and 43, as applied to claim 11 above; and 44-46 and 48-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee (US '221) in view of Yu (US '752), and further in view of Ngai et al. (US 6,518,106 B2); and

claim 47 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US '221) in view of Yu (US '752) and Ngai (US '106 B2), as applied respectively to claim 44 above, and further in view of Jerbic (US '614).

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Huang (US 20010003663 A1) discloses a high dielectric constant layer such as SiO₂ [0017] and Lui et al. (US 6,582,974) discloses conventional silicon

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oxide dioxide dielectric materials have comparatively high dielectric constants (column 1, lines 23-31).

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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August 27, 2007

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER

